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YY Canis Minoris: Contact or near contact system?*,**

P.G. Niarchos[1], **L. Mantegazza**[2], **E. Poretti**[2], **and V. Manimanis**[1]

[1] Section of Astrophysics, Department of Physics, University of Athens, Panepistimiopolis, GR-15784 Zografos, Athens, Greece
[2] Osservatorio Astronomico di Brera, Via Bianchi 46, 23807 Merate (LC), Italy

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Abstract. New V photoelectric observations of the eclipsing system YY CMi, obtained at La Silla, Chile, and Merate Observatory, Italy, are presented. New times of minima and ephemeris based on our observations are also given. The V light curve was analysed by using the WD code to derive the geometrical and physical parameters of the system. Since no spectroscopic mass ratio is available, the q-search method was applied to yield the preliminary range of the mass ratio in order to search for the final solution. First the unspotted solution was carried out by using the unperturbed parts of the light curve and applying the DC program of the WD code. The solution was performed by assuming contact (mode 3) and semi-detached (mode 4) configuration, since no classification of the system is possible from the shape of the light curve. The solution in mode 4 does not lead to an acceptable model, since the secondary was found to be slightly overcontact. Therefore the contact solution was finally adopted. Moreover the light curve peculiarities (Max II fainter than Max I and excess of light around the phase 0.32) were explained by assuming a cool and a hot spot on the surface of the secondary (cooler) component. The degree of contact is very small ($f \approx 3\%$) and the thermal contact is poor $(T_1 - T_2) \approx 650$ K. These results together with the high photometric mass ratio $q \approx 0.89$ indicate that YY CMi is very probably a system at the beginning or the end of the contact phase.

Key words: stars: YY CMi — binaries: eclipsing — starspots

1. Introduction

The light variability of YY CMi (≡HD67100) was discovered by Morgenroth (1934). Later photometric observations were due to Lause (1938), Soloviev (1940), Kaho (1950), and Kordylewsky & Szafraniec (1957). According to the General Catalogue of Variable Stars (GCVS, III ed., Kukarkin et al. 1969), the system is classified as a β Lyrae type eclipsing binary with a period of 1.0940253 d and a spectral type F5. Later, the spectrum was classed by Hill et al. (1975) as F6V at phase 0.31 and F7V at phase 0.71. The first complete light curve in three colours (u, b, y) was obtained by Abhyankar (1962), who also presented a solution based on Russell and Merrill method. From a questionable treatment of the colour indices, Abhyankar (1962) concluded that the system is composed of an F6III primary and an A5V secondary. Koch et al. (1970) noticed that YY CMi was probably a system of two (F5 + F8) main sequence stars.

Giuricin & Mardirossian (1981) reanalyzed Abhyankar's (1962) three–colour photoelectric observations by using Wood's (1972) model and found a solution appreciably different from the previous ones. The elements they derived lead to an evolved contact system consisting of a primary (roughly an F6 star) and a secondary (early G5) of practically equal sizes. This picture of the system is only an approximation of the real one, since Wood's model treats the stars as triaxial ellipsoids and does not handle contact systems very well.

2. Observations

YY CMi was observed in the framework of a two-site campaign (European Southern Observatory, La Silla, Chile and Merate Observatory, Italy) devoted to the δ Scuti star BI CMi (Mantegazza & Poretti 1994). The 277 ESO observations cover 14 consecutive nights (from JD 2448280 to JD 2448293), while the Merate ones are distributed over 8 nights (from JD 2448273 to JD 2448291). We have observations from the two sites in the same night for 5 cases;

Send offprint requests to: P.G. Niarchos
* Based on observations partly made at the European Southern Observatory (ESO).
** Table 1 is only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/Abstract.html

Table 1. Individual V observations of YY CMi

HJD 2448200+	ΔV	HJD 2448200+	ΔV	HJD 2448200+	ΔV	HJD 2448200+	ΔV	HJD 2448200+	ΔV	HJD 2448200+	ΔV
73.4463	2.363	80.4971	1.886	82.8047	2.064	85.6123	1.835	88.7217	2.093	90.5918	1.738
73.4629	2.424	80.5039	1.907	82.8145	2.024	85.6230	1.804	88.7305	2.156	90.6143	1.716
73.4688	2.430	80.5078	1.939	82.8252	1.984	85.6787	1.702	88.7412	2.227	90.6230	1.710
73.4736	2.423	80.5146	1.949	82.8359	1.939	85.6875	1.696	88.7803	2.429	90.6318	1.704
73.4854	2.367	80.5215	2.001	82.8486	1.907	85.6963	1.690	88.7891	2.416	90.6396	1.698
73.4941	2.308	80.5283	2.021	83.5898	1.629	85.7070	1.674	88.7988	2.375	90.6699	1.679
73.5049	2.228	80.5391	2.081	83.5986	1.641	85.7275	1.655	88.8105	2.293	90.6787	1.681
73.5117	2.192	80.5439	2.101	83.6074	1.638	85.7383	1.644	88.8213	2.224	90.6885	1.680
73.5186	2.148	80.5508	2.121	83.6152	1.646	85.7471	1.646	88.8320	2.142	90.7031	1.679
73.5293	2.058	80.5557	2.139	83.6240	1.642	85.7754	1.644	88.8447	2.061	90.7109	1.680
73.5352	2.025	80.5654	2.163	83.6328	1.651	85.7861	1.636	89.5400	1.697	90.7188	1.683
73.5400	1.993	80.5723	2.160	83.6572	1.669	85.7949	1.636	89.5488	1.693	90.7363	1.687
73.5479	1.960	80.5791	2.173	83.6807	1.678	85.8066	1.642	89.5693	1.688	90.7432	1.692
73.5547	1.922	80.5889	2.157	83.6895	1.685	85.8164	1.650	89.5781	1.682	90.7520	1.698
73.5645	1.872	80.5938	2.155	83.6992	1.706	85.8291	1.652	89.5869	1.676	90.7715	1.710
73.5742	1.850	80.6084	2.091	83.7080	1.714	85.8408	1.662	89.5967	1.680	90.7793	1.716
73.5898	1.796	80.6172	2.071	83.7305	1.741	86.5840	2.415	89.6172	1.677	90.7891	1.740
73.6064	1.780	80.6250	2.034	83.7383	1.758	86.5947	2.438	89.6348	1.682	90.7988	1.740
74.3906	1.729	80.6523	1.935	83.7471	1.784	86.6035	2.413	89.6465	1.690	90.8086	1.749
74.4023	1.747	80.6592	1.914	83.7559	1.802	86.6143	2.360	89.6563	1.696	90.8193	1.763
74.4160	1.776	80.6660	1.886	83.7646	1.827	86.6221	2.311	89.6719	1.711	90.8311	1.793
74.4258	1.790	80.6953	1.808	83.7900	1.929	86.6309	2.254	89.6797	1.717	90.8447	1.824
74.4326	1.819	80.7051	1.789	83.7998	1.969	86.6465	2.134	89.6885	1.725	90.8584	1.873
74.4473	1.849	80.7129	1.773	83.8105	2.019	86.6592	2.040	89.6963	1.736	91.3711	1.692
74.4561	1.885	80.7363	1.749	83.8213	2.072	86.6826	1.923	89.7178	1.762	91.3838	1.728
74.4658	1.928	80.7441	1.735	83.8330	2.104	86.6934	1.879	89.7256	1.772	91.3916	1.736
74.4727	1.950	80.7549	1.730	83.8447	2.157	86.7041	1.841	89.7432	1.798	91.4258	1.829
74.4805	2.001	80.7656	1.719	84.3760	2.293	86.7139	1.813	89.7656	1.867	91.4287	1.848
74.4941	2.072	80.7793	1.713	84.3838	2.385	86.7344	1.760	89.7744	1.899	91.5371	2.139
74.5059	2.140	80.7891	1.690	84.4023	2.425	86.7490	1.740	89.7822	1.918	91.5469	2.111
74.5107	2.167	80.8135	1.686	84.4150	2.420	86.7822	1.699	89.7910	1.944	91.5576	2.067
74.5215	2.258	80.8271	1.681	84.4199	2.390	86.7969	1.675	89.8008	2.006	91.5664	2.032
74.5273	2.311	80.8408	1.675	84.4287	2.349	86.8066	1.667	89.8105	2.062	91.5762	1.988
74.5371	2.369	81.5938	1.890	84.4375	2.293	86.8184	1.658	89.8223	2.136	91.5947	1.916
74.5488	2.411	81.6025	1.928	84.4473	2.217	86.8301	1.654	89.8369	2.237	91.6094	1.876
74.5547	2.440	81.6123	1.974	84.4541	2.157	86.8438	1.649	89.8496	2.329	91.7744	1.677
74.5625	2.465	81.6211	2.012	84.4629	2.108	87.5811	1.868	89.8604	2.369	91.7842	1.681
74.5674	2.438	81.6289	2.050	84.4736	2.041	87.5908	1.912	90.3613	1.940	91.7939	1.677
74.5742	2.426	81.6377	2.085	84.4814	1.985	87.6006	1.951	90.3691	1.968	91.8047	1.678
74.5879	2.329	81.6475	2.116	84.4883	1.949	87.6104	1.987	90.3740	2.000	91.8174	1.684
74.5938	2.297	81.6563	2.148	84.4932	1.934	87.6182	2.035	90.3848	2.036	91.8301	1.688
74.5977	2.254	81.7021	2.098	84.5010	1.896	87.6289	2.096	90.3926	2.075	91.8438	1.691
74.6035	2.214	81.7148	2.046	84.5166	1.842	87.6445	2.216	90.4004	2.102	91.8574	1.700
77.3975	1.846	81.7344	1.973	84.5186	1.839	87.6533	2.266	90.4053	2.112	92.5342	1.886
77.4063	1.823	81.7422	1.944	84.5264	1.806	87.6621	2.329	90.4121	2.144	92.5625	2.018
77.4121	1.809	81.7510	1.913	84.5371	1.807	87.6826	2.421	90.4141	2.151	92.5723	2.061
77.4297	1.767	81.7607	1.878	84.5459	1.758	87.6934	2.424	90.4209	2.150	92.5811	2.089
77.4414	1.756	81.7695	1.852	84.5850	1.706	87.7041	2.378	90.4277	2.149	92.6055	2.167
77.4492	1.743	81.7988	1.791	84.5938	1.697	87.7275	2.222	90.4336	2.145	92.6133	2.172
77.4590	1.730	82.3770	1.717	84.6035	1.684	87.7383	2.158	90.4414	2.127	92.6201	2.165
77.4736	1.719	82.3867	1.706	84.6133	1.672	87.7490	2.077	90.4453	2.120	92.6328	2.139
77.4893	1.704	82.3877	1.710	84.6211	1.664	87.7744	1.932	90.4512	2.115	92.6436	2.097
77.4971	1.709	82.4736	1.638	84.6309	1.657	87.7852	1.889	90.4580	2.080	92.6631	2.024
77.5039	1.702	82.4873	1.629	84.6396	1.653	87.7979	1.845	90.4639	2.047	92.6729	1.987
77.5156	1.689	82.5000	1.628	84.6611	1.642	87.8105	1.802	90.4707	2.024	92.6924	1.906
77.5273	1.691	82.5244	1.642	84.6826	1.640	87.8232	1.774	90.4746	2.009	92.7002	1.887
77.5332	1.690	82.5381	1.644	84.6904	1.633	87.8369	1.761	90.4795	1.998	92.7100	1.858
77.5371	1.684	82.5527	1.667	84.6992	1.638	87.8516	1.727	90.4834	1.970	92.7314	1.800

Table 1. continued

HJD 2448200+	ΔV	HJD 2448200+	ΔV	HJD 2448200+	ΔV	HJD 2448200+	ΔV	HJD 2448200+	ΔV	HJD 2448200+	ΔV
77.5498	1.679	82.6299	1.733	84.7080	1.641	88.5439	1.690	90.4902	1.949	92.7803	1.730
77.5605	1.681	82.6396	1.751	84.7334	1.656	88.5547	1.688	90.4961	1.934	92.7900	1.732
77.5693	1.665	82.6484	1.768	84.7422	1.657	88.5635	1.699	90.5049	1.905	92.8008	1.721
77.5859	1.690	82.6650	1.818	84.7520	1.663	88.5859	1.715	90.5088	1.883	92.8154	1.708
77.5967	1.686	82.6738	1.838	84.7646	1.679	88.5967	1.733	90.5166	1.855	92.8291	1.695
80.3955	1.669	82.6934	1.917	84.7891	1.696	88.6074	1.739	90.5205	1.852	92.8438	1.685
80.4131	1.705	82.7021	1.955	84.7979	1.706	88.6162	1.755	90.5264	1.860	92.8574	1.680
80.4268	1.706	82.7109	1.996	84.8076	1.718	88.6367	1.778	90.5303	1.851	93.5361	1.691
80.4453	1.730	82.7207	2.031	84.8174	1.733	88.6572	1.826	90.5352	1.828	93.5488	1.706
80.4502	1.746	82.7412	2.120	84.8262	1.747	88.6660	1.845	90.5420	1.811	93.5576	1.713
80.4600	1.748	82.7500	2.154	84.8389	1.771	88.6846	1.906	90.5479	1.796	93.5664	1.727
80.4688	1.790	82.7588	2.169	85.5850	1.937	88.6934	1.944	90.5508	1.792		
80.4824	1.833	82.7676	2.168	85.5938	1.898	88.7031	1.984	90.5586	1.784		
80.4902	1.857	82.7949	2.103	86.6035	1.870	88.7129	2.041	90.5840	1.742		

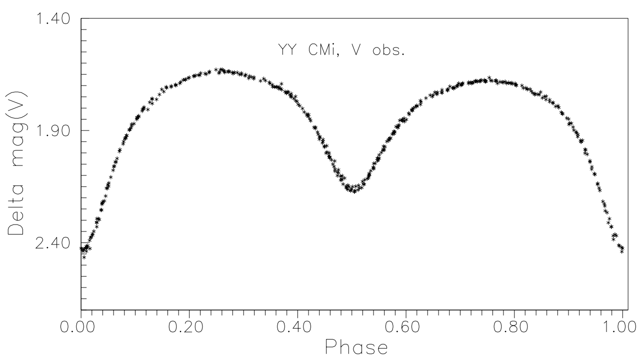

Fig. 1. The individual V observations of YY CMi

since on these nights there is a partial superimposition of the observations for almost two hours, it was possible to get an excellent alignment between the two datasets. The individual V observations are given in Table 1 and the respective light curve is shown in Fig. 1.

We have performed differential photometry in the V band with respect to the two comparison stars HD 66925 and HD 67028; since the light variability of the δ Sct star BI CMi was faster than that of YY CMi, the latter was measured once every five cycles. The comparison of the differential magnitudes between the two comparison stars has shown, as expected, a different accuracy between the data gathered at La Silla and at Merate: the former have a mean standard deviation of 4.4 mmag for each measurement, against the 8.6 mmag for the latter (a value quite high due to unfavourable declination of the field with respect to the latitude of Merate Observatory). Moreover, Mantegazza & Poretti (1994) discussed the possible microvariability of HD 67028.

3. The period of the system from the times of minima

The present observations, obtained at Merate Observatory and ESO, were used to calculate new times of minima by using Kwee & Van Woerden (KW) method. The new minima times are given in Table 2. The successive columns give the HJD of minimum, the error, the number of cycles E, the (O − C) values and the type of minimum (I: primary, II: secondary). A least–squares solution, applied to all minima listed in Table 2, yields the following ephemeris

Table 2. New times of minima of YY CMi

JD Hel. 24 40000	Error	E	O − C	Type of minimum
8273.4650	0.0050	−13.0	0.0007	I
8274.5561	0.0006	−12.0	−0.0020	I
8280.5688	0.0082	−6.5	−0.0052	II
8281.6774	0.0044	−5.5	0.0097	II
8282.7544	0.0041	−4.5	−0.0071	II
8284.4080	0.0050	−3.0	0.0058	I
8287.6896	0.0030	0.0	0.0060	I
8288.7719	0.0023	1.0	−0.0055	I
8290.4151	0.0018	2.5	−0.0029	II
8292.6061	0.0007	4.5	0.0005	II

$$\text{J.D.Hel. (Min I)} = 2448287.6836 + 1.0937869 \cdot E$$
$$\pm 0.0023 \pm 0.0003484$$

which has been used for the calculation of O − C values.

The O − C behaviour for all the existing minima times, computed by using the above ephemeris, is shown in Fig. 2. The existing data are not enough to draw definite conclusions about the variation of the period. The GCSV, IV ed., (Kholopov et al. 1985) gives a period 1.0940197 d. This period was calculated by Abhyankar (1962) using well determined minima times over a period of 24 years. Our new ephemeris, based on the present observations, suggests a shorter period.

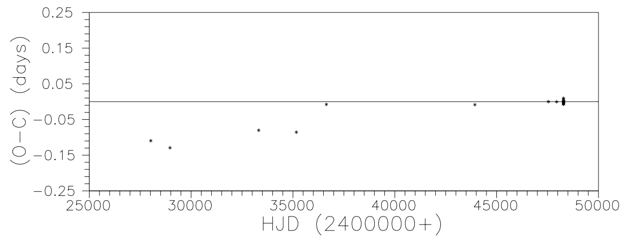

Fig. 2. The O − C diagram of YY CMi

Table 3. Normal points for YY CMi in light units

phase	l_V	n	phase	l_V	n
0.00783	0.48137	11.0	0.50773	0.61695	8.0
0.02287	0.51976	10.0	0.52366	0.63518	7.0
0.03789	0.57334	10.0	0.53646	0.66575	10.0
0.05239	0.63842	8.0	0.55349	0.71225	12.0
0.06562	0.69908	6.0	0.56933	0.75813	6.0
0.08267	0.76389	9.0	0.58190	0.78970	11.0
0.09990	0.81603	10.0	0.59689	0.82158	7.0
0.11422	0.85608	5.0	0.61420	0.85730	9.0
0.12828	0.87877	5.0	0.62881	0.88346	4.0
0.14416	0.90881	3.0	0.64715	0.90434	3.0
0.15985	0.93352	5.0	0.65910	0.91634	6.0
0.17454	0.94462	3.0	0.67556	0.92649	5.0
0.18769	0.96072	5.0	0.69124	0.93876	8.0
0.20482	0.97750	5.0	0.70327	0.94778	4.0
0.21864	0.98643	3.0	0.71938	0.95337	6.0
0.23310	0.99242	4.0	0.73380	0.96041	8.0
0.25381	1.00000	4.0	0.74856	0.96248	7.0
0.26586	0.99982	6.0	0.76533	0.95914	5.0
0.27942	0.99460	5.0	0.77979	0.95545	5.0
0.29477	0.98801	5.0	0.79565	0.95080	7.0
0.30943	0.97813	4.0	0.80974	0.94060	4.0
0.32286	0.96843	3.0	0.82615	0.92802	5.0
0.34133	0.96221	3.0	0.84137	0.91143	6.0
0.35564	0.94087	6.0	0.85597	0.89722	4.0
0.37072	0.92964	7.0	0.86969	0.87827	5.0
0.38562	0.90732	9.0	0.88500	0.85045	5.0
0.40026	0.87768	6.0	0.90195	0.80985	6.0
0.41852	0.83159	7.0	0.91745	0.76525	8.0
0.43452	0.78076	6.0	0.93045	0.72516	5.0
0.44748	0.74103	10.0	0.94591	0.66138	8.0
0.46273	0.69124	11.0	0.96274	0.58903	6.0
0.47808	0.64879	10.0	0.97808	0.52715	8.0
0.49287	0.62114	10.0	0.99542	0.48774	7.0

4. Light curve analysis

The light curve analysis is quite difficult for the following reasons: (a) no spectroscopic mass-ratio is known; (b) the maxima of the light curve are unequal in brigthness (Max I brighter than Max II); (c) the system undergoes only partial eclipses. An inspection of the light curve reveals that brightness variations occur not only around the maxima, but also at other phases. More specifically, a decrease in brightness is present in the phase interval 0.59 − 0.87 and a small excess of light is seen around phase 0.32. Other minor light variations can be seen in other phase regions. The magnitude difference between the two maxima is about Max II − Max I = 0.03 mag. In modelling light curves of systems exhibiting light curve anomalies, the need to place hot and/or cool spots of solar type has been suggested by several investigators (e.g. Binnendijk 1960; Hilditch 1981; Linnell 1982; Van Hamme & Wilson 1985; Milone et al. 1987; van't Veer & Maceroni 1988, 1989; Maceroni et al. 1990).

4.1. Unspotted solution

The most recent (1996) version of the Wilson-Devinney (Wilson 1990) synthetic light curve code was used for the light curve solution. 66 normal points, listed in Table 3, were used and weights equal to the number of observations per normal were assigned. Both unspotted and spotted solutions were performed; for the latter, we assumed the presence of cool and hot spots to explain the difference in brightness between the two maxima and the excess of light, respectively. Under these assumptions we excluded the observations in the phase interval 0.59 − 0.87 from the unspotted solution, since a significant decrease of brightness occurs.

The subscripts 1 and 2 refer to the component eclipsed at primary and secondary minimum, respectively. A preliminary set of input parameters for the DC program was obtained by the Binary Maker 2.0 program (Bradstreet 1993). The DC program was used in the contact mode 3 and in the semidetached mode 4. In the subsequent analysis the following assumptions were made: a mean surface temperature $T_1 = 6360$ K according to the spectral type F6V; we assigned typical values for stars with convective envelopes to bolometric albedos and gravity darkening coefficients; limb darkening coefficients were taken from Al-Naimiy's (1978) tables and bolometric linear limb darkening coefficients from Van Hamme (1993). Third light was assumed to be $\ell_3 = 0$. The adjustable parameters were: the phase of conjunction ϕ_0, the inclination i, the temperature T_2, the nondimensional potential Ω_1 in mode 3 and Ω_2 in mode 4, the monochromatic luminosity L_1 and the mass-ratio $q = m_2/m_1$.

Since no spectroscopic mass-ratio of the system is known, a search for the solution was made for a mass-ratio q ranging from 0.2 to 4. The lowest values of the sum $\Sigma(\mathrm{res})^2$ of the weighted squared residuals occured around $q = 1.0$ in mode 3 and $q = 0.8$ in mode 4. Figure 3 shows the fit parameters $\Sigma(\mathrm{res})^2$ as a function of the mass-ratio q in modes 3 and 4. In order to find the final unspotted solution we continued the analysis by applying the DC program for both cases. The two solutions converged to $q = 0.8921$ in mode 3 and $q = 0.8295$ in mode 4. The corresponding values of $\Sigma(\mathrm{res})^2$ were found to be 0.0785 and 0.0835, respectively. Of these two solutions, we finally adopted the solution in mode 3 (with $q = 0.8921$) by

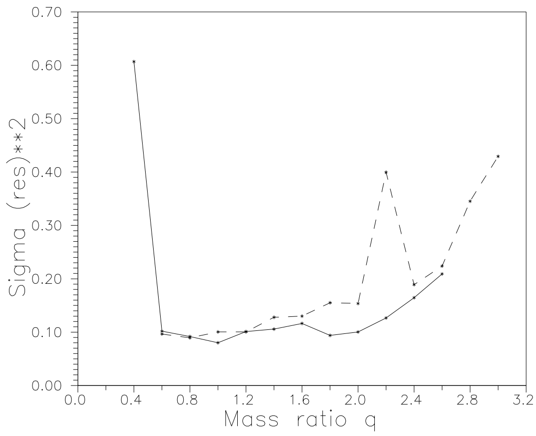

Fig. 3. The fit parameter $\Sigma(\mathrm{res})^2$ as a function of the mass-ratio q. Solid lines: mode 3; dashed lines: mode 4

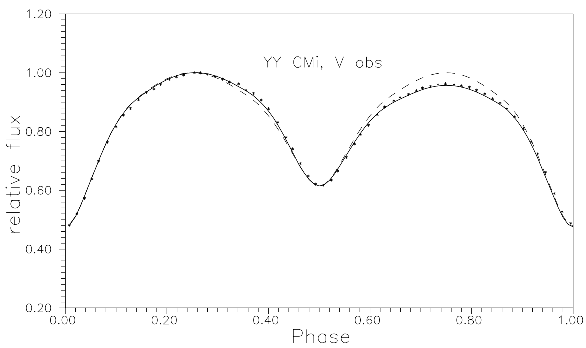

Fig. 4. Normal points and theoretical V light curves of YY CMi. Dashed lines: unspotted solution; solid lines: spotted solution

taking into account the better fit of the solution in mode 3 and the fact that the secondary exceeds the Roche lobe ($\Omega_2 < \Omega_{\mathrm{in}}$) in mode 4. The results of the unspotted solution are given in Table 4 and the corresponding theoretical light curves are shown as dashed lines in Fig. 4.

4.2. Spotted solution

The spotted solution was carried out by adopting the simplest spot model with a physical meaning. We started by assuming that the system had a cool spot on the secondary (cooler) component of the same nature as solar magnetic spots (Mullan 1975). Such a spot could explain the decrease of brightness in the phase interval $0.59-0.87$. Another hot spot was assumed on the secondary component near the neck region in order to match the light excess around phase 0.32. Such a bright region can be explained as a result of energy transfer from the primary to the secondary component (Van Hamme & Wilson 1985).

The *Binary Maker 2.0* program was used to obtain the best fit by adjusting the spot parameters: the latitude b, the longitude l, the angular radius R and the temperature factor T.F. Once the best fit was obtained, the DC program was used to derive the final solution. The program allows the adjustment of spot parameters. The results of the spotted solution are also given in Table 4 and the theoretical light curves are shown as solid lines in Fig. 4. The O − C differences between the observed and calculated points for the unspotted and spotted solution for the system are shown in Fig. 5.

Table 4. Light curve solutions of YY CMi

Parameter	unspotted solution	spotted solution
ϕ_0	0.0026 ± 0.0003	0.0026 ± 0.0003
i (degrees)	79.50 ± 0.16	79.47 ± 0.07
$g_1 (= g_2)$	0.32^*	0.32^*
T_1 (K)	6360^*	6360^*
T_2 (K)	5707 ± 11	5710 ± 4
A_1 $(= A_2)$	0.5^*	0.5^*
Ω_1 $(= \Omega_2)$	3.558 ± 0.013	3.560 ± 0.006
$q = m_2/m_1$	0.892 ± 0.011	0.885 ± 0.004
$L_1/(L_1 + L_2)$ (V)	0.641 ± 0.003	0.642 ± 0.002
x_1 $(= x_2)$ (V)	0.60^*	0.60^*
x_1 $(= x_2)$ (bolo)	0.50^*	0.50^*
% overcontact	3%	0.3%
r_1 (pole)	0.368 ± 0.001	0.367 ± 0.001
r_1 (side)	0.387 ± 0.001	0.386 ± 0.001
r_1 (back)	0.418 ± 0.002	0.416 ± 0.001
r_2 (pole)	0.348 ± 0.003	0.346 ± 0.001
r_2 (side)	0.366 ± 0.004	0.363 ± 0.002
r_2 (back)	0.398 ± 0.006	0.395 ± 0.003
$\Sigma_{(}\mathrm{res})^2$	0.0785	0.0137
$\mathcal{M}_1/\mathcal{M}_\odot$		1.25
$\mathcal{M}_2/\mathcal{M}_\odot$		1.12^*
$R_1/R_\odot$		2.32
$R_2/R_\odot$		2.20
$\log(L_1/L_\odot)$		0.91
$\log(L_2/L_\odot)$		0.67

*assumed.

The parameters of the cool spot on the primary component are: latitude $b = 90°$ (fixed), longitude $l = 271.27° \pm 0.91°$, angular radius $R = 22.33° \pm 4.51°$ and temperature factor T.F. $= 0.84 \pm 0.09$. Those of the hot spot are: latitude $b = 90°$ (fixed), longitude $l = 21.26° \pm 1.95°$, angular radius $R = 9.32° \pm 2.69°$ and temperature factor T.F. $= 1.19 \pm 0.09$. A three dimensional picture of the spotted model at phases 0.25 and 0.75 is shown in Fig. 6, while the cross-sectional surface outline of the system together with the respective critical Roche lobes are given in Fig. 7.

5. Conclusions

The adopted spot model for YY CMi fits extremely well the observed light curves. The absolute elements based on its spectral classification and the present photometric solution are also given in Table 4. We can use these elements to estimate the evolutionary status by means of

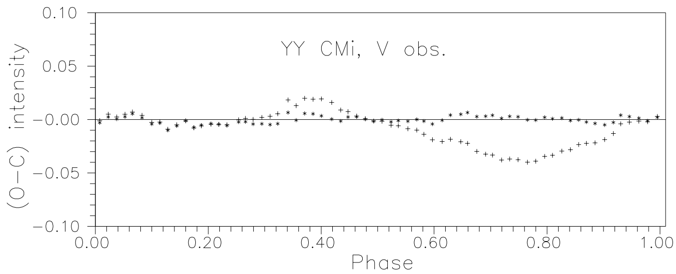

Fig. 5. The light curve (O − C) residuals for YY CMi in V band. Crosses refer to unspotted solution; asterisks refer to spotted solution

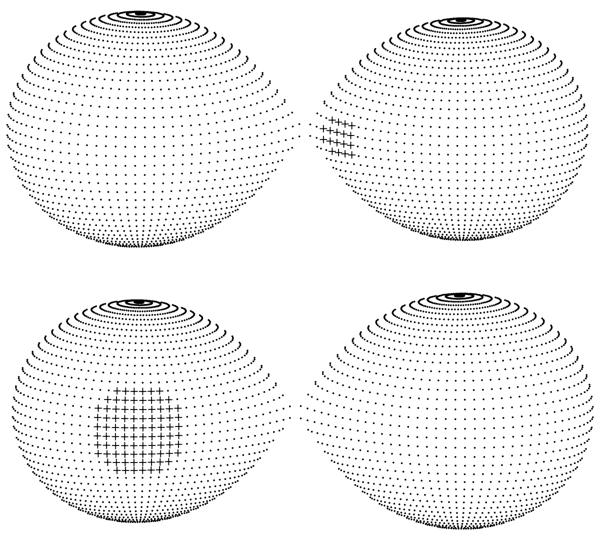

Fig. 6. A three-dimensional model of YY CMi for phases 0.25 (upper plot) and 0.75 (lower plot)

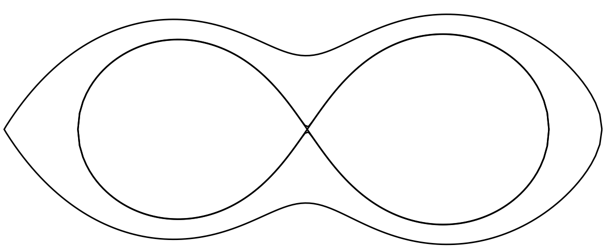

Fig. 7. Cross-sectional surface outline of YY CMi. It coincides with the inner Roche critical surface

the mass-radius (MR), mass-luminosity (ML) and HR diagrams of Hilditch et al. (1988). In these diagrams, both components of YY CMi lie beyond the TAMS, in a region occupied mostly by the primaries of A-type W UMa systems.

On the other hand, the degree of contact is almost zero (indicating marginal contact) and the thermal contact is poor $(T_1 - T_2) \approx 650$ K. These results together with the high photometric mass-ratio $q \approx 0.88$ indicate that YY CMi is very probably a system at the beginning or the end of the contact phase (Lucy & Wilson 1979). However, more definite conclusions about the evolutionary status of YY CMi can only be drawn by means of new photometric and spectroscopic observations of the system.

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